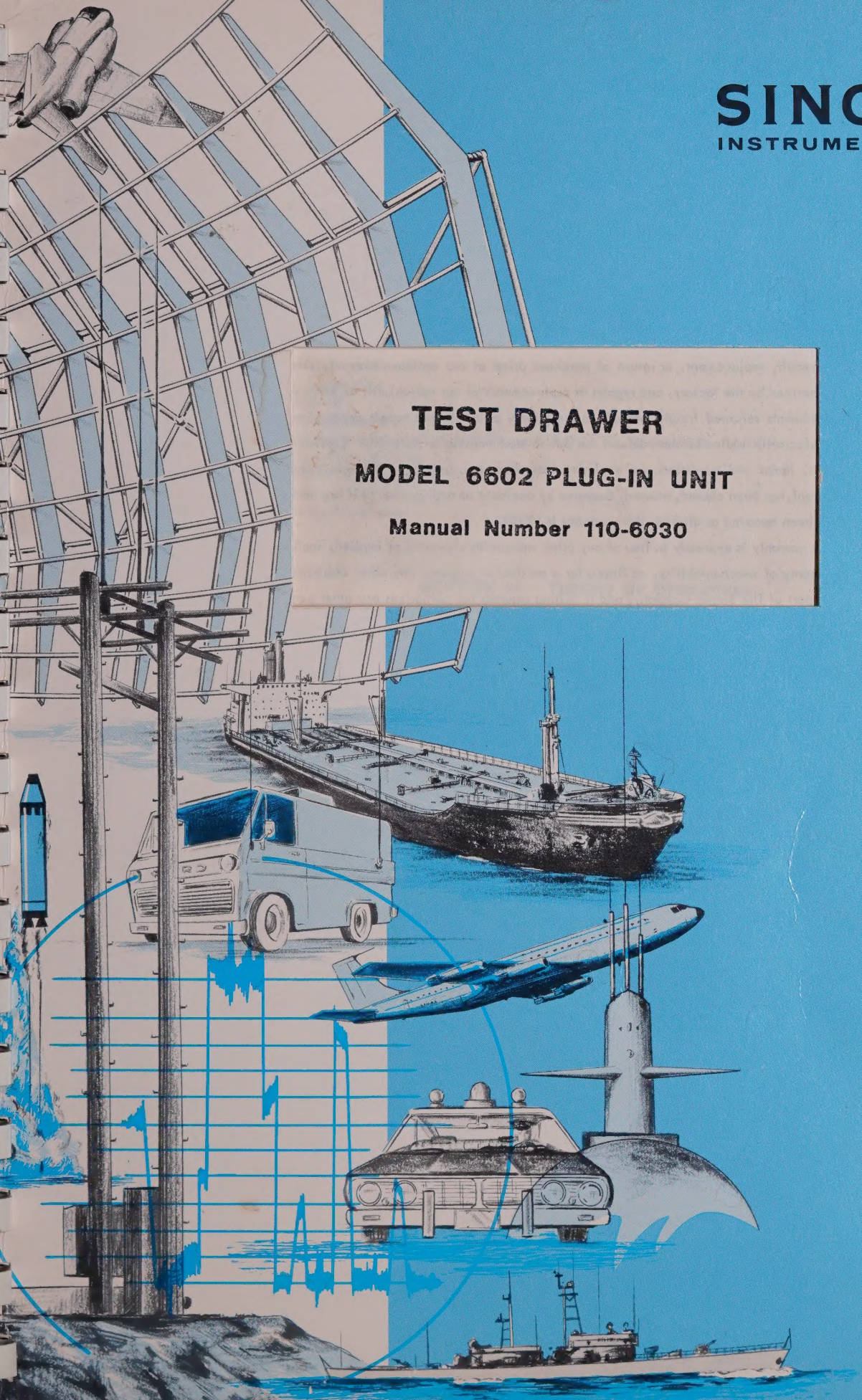
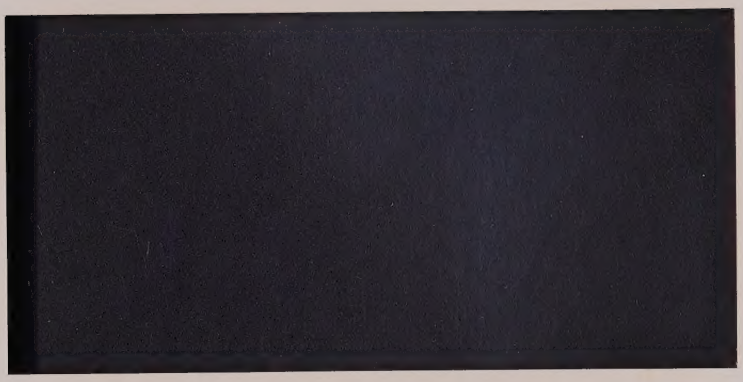
SINGER
INSTRUMENTATION

TEST DRAWER

MODEL 6602 PLUG-IN UNIT

Manual Number 110-6030





INSTRUCTION MANUAL

TEST DRAWER

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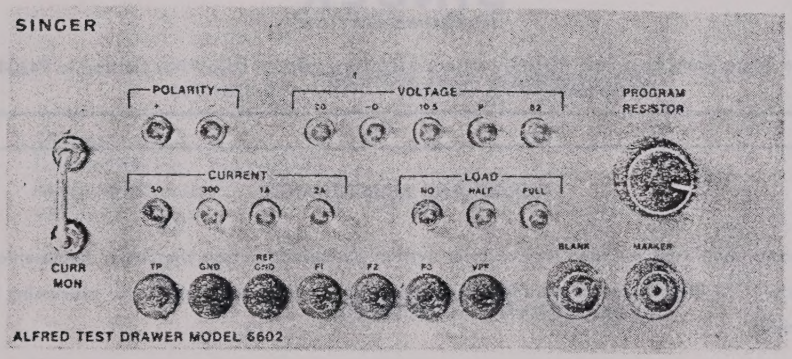

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The Singer Company, Palo Alto Operation

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Instruments should be returned only on prior written authorization from the Singer Representative or the factory(1). Please provide the following information in order to expedite our processing of your instrument:

1. Model or Type
2. Serial Number
3. Approximate date instrument was placed in operation
4. Approximate number of hours of use
5. Description of trouble(2)
6. Has maintenance action been previously requested?
7. Other comments

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument prepaid to the specified center or factory. If requested, an estimate of charges will be made before work begins.

(1) West Coast Service Center, 3211 S. LaCienega Blvd., Los Angeles, California 90016, Telephone (213) 870-2761, TWX 910-340-6352 for all Singer Instrumentation equipment; or Palo Alto Operation, 3176 Porter Drive, Palo Alto, California 94304, Telephone (415) 493-3231 TWX 910-373-1765 for Palo Alto Operation instruments.

(2) Include data on symptoms, measurements taken, test instruments used, suspected location of trouble, maintenance action taken, and any other relevant data.

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SECTION I
GENERAL INFORMATION

1-1. GENERAL DESCRIPTION.

1-2. The Model 6602 Test Drawer is a plug-in unit for Models 6600 and 6600A main frames. It provides various loads for the main frame power supplies and test points for determining voltages and waveforms produced in the main frame. It is used, principally, for aligning the main frame, using alignment procedures which are in the main frame manuals.

TABLE 1-1. SPECIFICATIONS

MODEL 6602 TEST DRAWER

Constant Current Loads for Selected Voltage Sources in Main Frame.

Accuracy: ±2%

Voltage Source	Load Currents				Limiting Current For Supply
±20 Volts	50 mA	300 mA	1A		1.5A
- Diode Voltage *	50 mA	300 mA	1A		1.5A
±10.5 Volts	50 mA				150 mA
+ Program Voltage	50 mA	300 mA	1A		1.5A
- Program Voltage	50 mA	300 mA	1A	2A	2.0A
±62 Volts	50 mA	300 mA			400 mA

Above are currents for FULL LOAD selection on 6602. HALF LOAD selection draws 50% of FULL LOAD ±1%. NO LOAD Selection draws less than 1 ma, except for a steady 10 ma load on +20V or -20V.
- Diode and ± Program Voltages may be varied by variation of setting of the Program Resistor.

Test Points Are:

TP	Connected to voltage under load.
GND	Common Ground of the main frame.
REF GND	Reference Ground of the main frame.
F1	F1 Tuning Signal Output of main frame.
F2	F2 Tuning Signal Output of main frame.
F3	F3 Tuning Signal Output of main frame.
VPF	Voltage Proportional to Frequency Output of main frame.
Blank	BNC connection to main frame. Blanking signal for plug-in.
Marker	BNC connection to main frame. Marker signal for plug-in.
Current Monitor	Jacks with removable shorting bar in series with Load Current. (See Tables 2-2 and 2-3)

* The - Diode Voltage Supply does not exist in Model 6600A or in Model 6600 with serial numbers larger than 39.

SECTION II
OPERATION

2-1. INCOMING INSPECTION.

2-2. The 6602 plug-in unit is shipped ready for use. Unpack and check the contents of all shipping containers against the packing invoice to be sure the order is complete. Check the unit for shipping damage. The front panel control should move easily, with full travel. Note any mechanical damage, and check the condition of accessories shipped with the unit. If there is any damage or deficiency, or if electrical performance is not within specifications, see the warranty inside the front cover of this manual.

2-3. Inspect the unit for humidity and heat damage after any long storage period. Minimum performance tests should be made after each of these inspections. No attempt should be made to make any repairs to the plug-in unit or to make adjustments without complete familiarization with the information contained in Section IV.

2-4. POWER CONNECTION.

2-5. All power is supplied by the 6600 or 6600A main frame.

2-6. ENVIRONMENT.

2-7. The 6602 plug-in unit is always used to test the 6600 or 6600A main frame assembly. Tests should be made in normal laboratory environment.

2-8. PRELIMINARY INSPECTIONS.

2-9. Preliminary inspection of the equipment is performed on the plug-in unit without operating power applied. This type of check is designed to detect conditions that might otherwise lead to a breakdown. Frequency causes of premature failure are overheating, due to improper ventilation or accumulation of dust and dirt, and/or loose connections and fittings. Inspection is carried out with emphasis on finding evidence of these conditions. Table 2-3 lists the preliminary inspection checks for the equipment.

2-10. INSTALLATION AND REMOVAL OF 6602 PLUG-IN UNIT IN THE MODEL 6600 OR 6600A.

NOTE

When changing plug-in unit, turn the POWER switch off and wait 15 seconds before removing the plug-in unit to permit decay of the power supply voltages. Do not insert 6602 plug-in unit into main frame with power turned ON.

2-11. INSTALLING PLUG-IN UNITS.

2-12. Push the plug-in unit into the receptacle in the 6600(A) panel. A black lever at the left of the plug-in will rise to mid-position as the plug-in panel becomes flush with the 6600(A) panel. Push the lever into position at the top left corner of the plug-in.

2-13 REMOVAL OF PLUG-IN UNITS.

2-14. Pull out the black lever at the left of the plug-in unit. This will cause the plug-in unit to move out of the 6600(A) panel. Remove plug-in unit by holding edges of plug-in panel and pulling out of the 6600(A).

2-15. CONTROLS AND CONNECTORS.

2-16. All controls and connectors of the 6602 are shown in Figures 2-1 and 2-2. They are described in Tables 2-1 and 2-2.

2-17. OPERATING PROCEDURES.

2-18. Use of the 6602 is described in the Alignment Procedures for Models 6600 and 6600A. Follow these procedures to calibrate the Main Frames prior to use with Plug-In Units, if the equipment has been in storage or out of use for as much as several months or if a Plug-In does not operate properly in the Main Frame.

TABLE 2-1. MODEL 6602 FRONT PANEL CONTROL AND CONNECTORS

Index	Control or Connector	Function
1	Voltage, ±62 V Pushbutton, S1	Connects ±62 Volt Supply to Load and to Test Point, TP.
2	Voltage, P Pushbutton, S2	Connects ± Program Voltage to Load and to Test Point, TP. Connects Item 15 in Program Voltage Control Circuit.
3	Voltage, ±10.5 Pushbutton, S3	Connects ±10.5 Volt Supply to Load and to Test Point, TP.
4	Voltage, -D Pushbutton, S4	Connects - Diode Supply to Load and to Test Point, TP. Connects Item 15 in - Diode Voltage Control Circuit. (-Diode Supply does not exist in present main frames).
5	Voltage, ±20 Pushbutton, S5	Connects ±20 Volt Supply to Load and to Test Point, TP.
6	Polarity, - Pushbutton, S6	Connects negative source of voltage chosen by index numbers 1 through 5.
7	Polarity, + Pushbutton, S7	Connects positive source of voltage chosen by index numbers 1 through 5. If -D is chosen, applies no load to the -D supply. See Item 4.
8	Load, Full Pushbutton, S8	Applies load equal to current markings of items 11 through 14.
9	Load, Half Pushbutton, S9	Applies load equal to one half of current markings of Items 11 through 14.
10	Load, No Pushbutton, S10	Draws No Current for selected supply.
11	Current, 2A Pushbutton, S11	Selects 2 Ampere load for selected supply.
12	Current, 1A Pushbutton, S12	Selects 1 Ampere load for selected supply.
13.	Current, 300 mA Pushbutton, S13	Selects 300 milliampere load for selected supply.
14.	Current, 50 mA Pushbutton, S14	Selects 50 milliampere load for selected supply.
15	Program Resistor Control	Adjusts Program or Diode Supply Voltage by varying bias resistance.
16	Marker Connector	Provides connection to RF Marker signal line from main frame.
17	Blank Connector	Provides connection to RF Blank and RF AM signal line from main frame.
18	VPF Test Point	Provides connection to Voltage Proportional to Frequency signal line of main frame.
19	F3 Test Point	Provides connection to F3, Frequency Control, signal line of main frame.
20	F2 Test Point	Provides connection to F2, Frequency Control, signal line of main frame.
21	F1 Test Point	Provides connection to F1, Frequency Control, signal line of main frame.
22	REF GND Test Point	Provides connection to Reference Ground of main frame. All voltage measurements are made with respect to reference ground.
23	GND Test Point	Provides connection to common Ground of main frame. This test point is for general use.

TABLE 2-1. MODEL 6602 FRONT PANEL CONTROL AND CONNECTORS (Continued)

Index	Control or Connector	Function
24	TP Test Point	This test point is connected to the selected polarity of the selected voltage supplied from the main frame. To measure voltage, connect between this point and Reference Ground, Index 22.
25	CURR MON Test Point, Lower	Current return connection for monitoring current drawn from selected voltage supply.
26	CURR MON Test Point, Upper	Current source connection for monitoring current drawn from selected voltage supply.
27	Jumper for CURR MON Test Points	Replace Jumper with Ammeter to monitor current. Jumper or Ammeter must be in place for current to be drawn from selected supply.

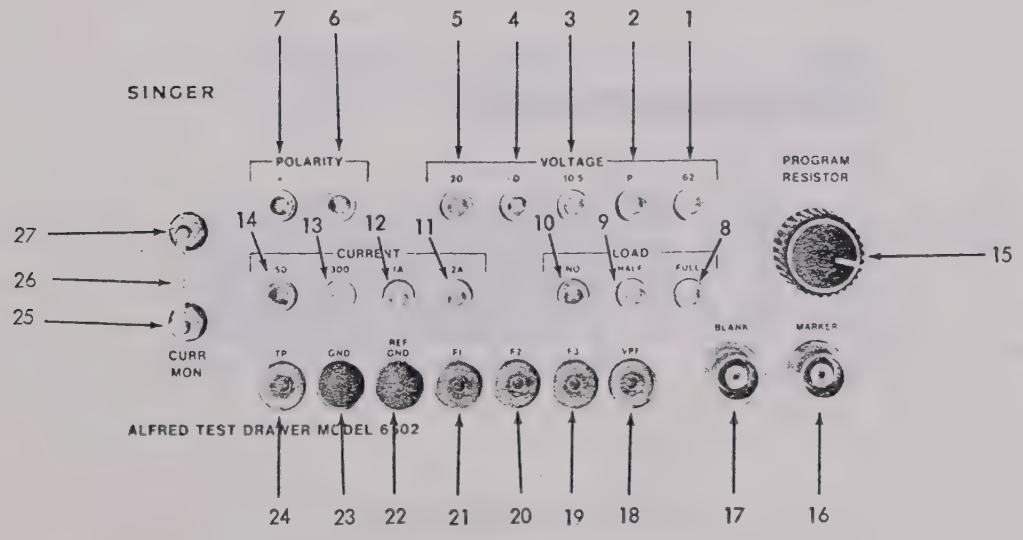


Figure 2-1. Model 6602 Front Panel

TABLE 2-2. MODEL 6602 REAR PANEL CONNECTORS

Index	Connector	Function
1	Printed Circuit Board Plug	Connector to main frame.
2	BNC Connector	Input to a timing circuit (paragraph 4-10)which holds VPF at top of sweep for >1 second so that the peak voltage may be measured with a digital voltmeter. Input is via a coaxial cable from Negative Blanking Output Connector of the main frame.
3	Red Test Point	Connector to Ramp Control Input of main frame. Voltage is at ground during holding period of timing circuit, Index 2. It is used for control of the DVM.

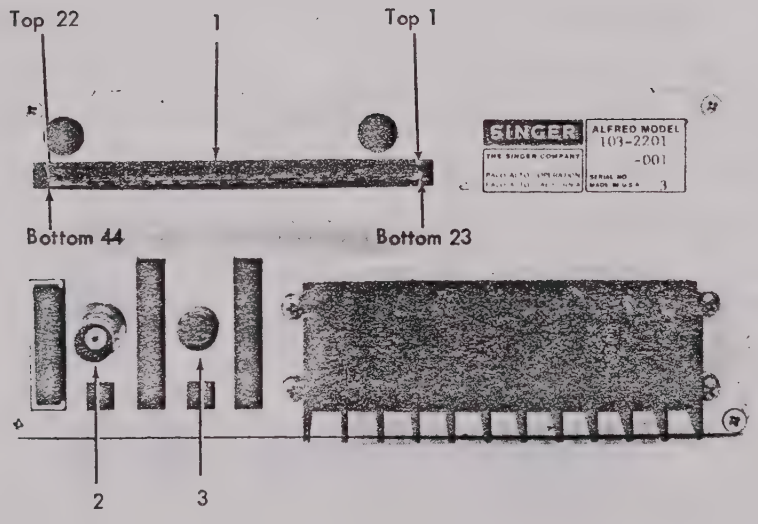


Figure 2-2. Model 6602 Rear Panel

TABLE 2-3. PRELIMINARY INSPECTION CHECKS

Item	Inspect For	Corrective Action
Connectors	Looseness, bent or corroded contacts, signs of arcing.	Clean contacts with cloth moistened with cleaning solvent trichloroethylene or equivalent.
		Replace connectors if damaged or deeply corroded.
Main Frame and front panel	Dirt and corrosion	Clean with cloth moistened with cleaning solvent trichloroethylene or equivalent.
Knobs, screws, connectors, clamps	Looseness	Tighten using appropriate torque so as not to strip threads.
Switches	Looseness	Tighten mounting screws or nut.
Wiring	Looseness	Resolder, recable, or reclamp.
	Frayed, worn, or missing insulation	Replace as required.
Solder joints	Loose or cold solder connections; corrosion	Clean carefully and resolder, using recommended soldering iron.
Printed circuit boards	Mounting looseness	Replace mating plug if required.
	Loose components	Resolder loose components.
Resistors	Cracks, chipping, blistering, discoloration, and other signs of overheating.	Replace with exact match or original.
Capacitors	Leaks, bulges, signs of aging.	Replace capacitor.
	Loose mounting bracket	Tighten nuts or screws holding bracket.
Switch contacts	Dirt, dust and/or corrosion	Clean with cloth, aerosol spray, syringe or camel-hair brush using trichloroethylene or equivalent.
	Bent or broken contacts	Replace switch wafer or assembly.
Transistors	Looseness	Seat firmly in sockets, or resolder leads to etched circuit.

SECTION III
THEORY OF OPERATION

3-1. GENERAL FUNCTIONS.

3-2. The Model 6602 provides variable loads for the DC Supplies of the Model 6600(A) Main Frames and access to the supply terminals. This allows determination of the voltages supplied under various load conditions. It also provides loads for the various sweep and pulse signals produced in the 6600(A) and provides access to the signal lines so that an oscilloscope or a voltmeter may be used to monitor wave forms for determination whether the 6600(A) is within specified limits.

CIRCUIT DESCRIPTIONS. Figure 4-1.

3-4. The 6602 provides a path for current from a positive voltage to ground via transistors Q1 and Q3, resistors R7 and R8, the Current Loop jumper from E37 to E47 and resistors R4 and R4A or R3 and R3A or R7 and R7A. Voltage at the arm of switch S14 is compared, by operational amplifier U1, with a reference voltage from the R14, R15, R16, R17 voltage divider. U1 feeds a signal back to the bases of Q1 and Q3 to control current flow so that the inputs to U1 are equal.

3-5. Switches S9, S10 and S11 control which reference point is used. Switches S13 and S14 determine the resistance of the load across which the load voltage is measured. Variation of switch positions allows the load current to be controlled to be zero, 50 mA, 300 mA, 1A or 2A, ±1% so long as the supply voltage is maintained. If a 6600(A) supply is over loaded by the 6602 circuit, its output voltage drops, usually to close to zero. No damage is done to either the 6600(A) or the 6602.

3-6. Current from a negative voltage passes through transistors Q2 and Q4, resistors R9 and R11, the Current Loop, jumper and the same load resistors as are used for current from a positive voltage. Regulation of current is the same as indicated in paragraphs 3-4 and 3-5.

3-7. Switches S1, S2, S3, S4, S5 and S6 control the connections of the loads to the various voltage supplies. Each polarity of input voltage connects only to the proper polarity load.

3-8. Switch S7 connects the reference voltage divider to +20 volts or -20 volts, thereby cutting off the negative load or the positive load transistors. A positive return from the reference to pin 3 of U1 insures a positive output from pin 6 unless the input to pin 2 is as positive as that to pin 3. Negative current flow can only feed negative voltage back to pin 2, so pin 6 is positive and transistors Q2 and Q4 are cut off. Positive voltage from U1 turns on transistors Q1 and Q3 so that positive current flows and positive voltage is fed back to pin 2 of U1 to balance that fed to pin 3.

3-9. Switch S13, the 300 mA switch, switches the load resistors from R7 and R7A to R3 and R3A. Additional contacts switch 50 ohm series resistors into the circuits from ± program voltage and ±62 volts. This reduces the voltage across and the heat dissipated by the current regulating transistors when the high voltage supplies are loaded.

3-10. The circuit which contains transistors Q5, Q6 and Q7 is a one shot multivibrator. Q6 is normally saturated due to base current through R22. This leaves Q5 cut off. When a positive-going pulse is applied to the base of Q1, from the + Blanking Jack on the rear of the 6600(A) via the scope Blank connector on the rear of the 6602, Q5 turns on, cutting off Q6, via capacitor C3. This applies about 12 volts to R18 which keeps Q5 saturated until C3 is charged via R22, and Q6 turns on, removing voltage from R18, hence cutting off current through Q5 which occurs at maximum ramp voltage point, ramp voltage (VPF) is held at maximum until the one-shot recovers. This period of time is more than one second, allowing measurement of peak voltage with the use of a standard voltmeter.

3-11. PART LOCATIONS.

3-12. Part Locations are shown in Figure 3-1 and Figure 3-2. All electronic parts are designated except the switches, and test jacks, which are shown in Figure 2-1 and described in Table 2-1. Terminals E1 through E47 are located in either Figure 3-1 or Figure 3-2 or both.

3-13. PARAGRAPH REFERENCES.

3-14. Paragraph numbers shown in white on black indicate paragraphs which describe the circuits in the figure which also shows the paragraph numbers. Paragraph headings indicate the figure number 4-1.

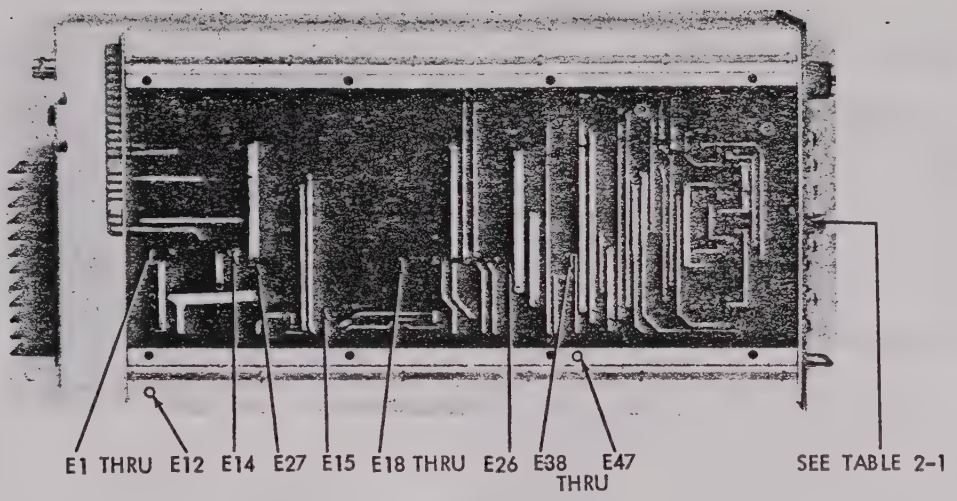


Figure 3-1. Model 6602 Top View

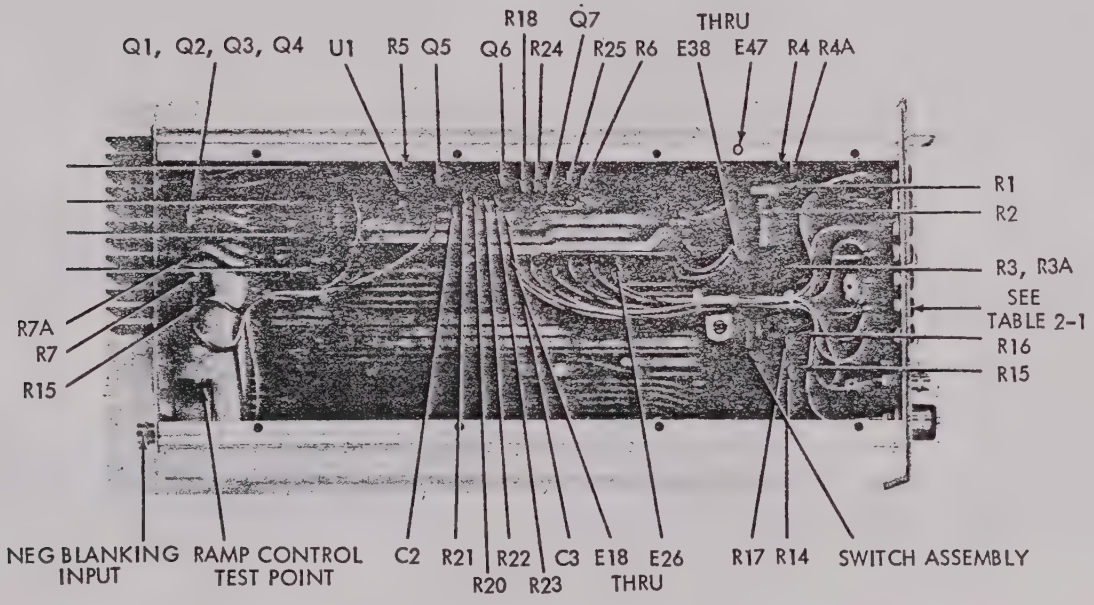


Figure 3-2. Model 6602 Bottom View

SECTION IV
MAINTENANCE

4-1. GENERAL.

4-2. The Model 6602 is a laboratory model test instrument, designed for use in normal laboratory environment, however liberal safety factors allow use in ambient temperatures from well below 0°C to around +70°C. Only reasonable care is required to keep the unit operating properly. Table 2-1 lists inspection checks which should be made periodically.

4-3. TROUBLESHOOTING. Figure 4-1.

4-4. The three circuits used in the 6602 are simple and are fully described in Section 3. Troubleshooting procedures are described immediately hereafter.

4-5. REGULATOR CIRCUITS. Figure 4-1.

4-6. To determine amount and direction of current flow, remove Current Loop jumper from the left of the front panel and substitute an ammeter. If current flow is in the wrong direction, switch S7 is at fault or one or more of the transistors Q1 through Q4 is shorted. Check base, emitter and collector voltages to find short.

4-7. If current flow is not the proper amount, check voltages at E30 and E37. They should be the same within one or two millivolts. If they are not, check voltage at pin 6 of U1. If this voltage is close to +20 volts or -20 volts, one or more of transistors Q1 through Q4 is at fault or one of resistors R8 through R11 is open. If pin 6 of U1 shows a voltage within one or two volts of ground, U1 is faulty or R5 is shorted.

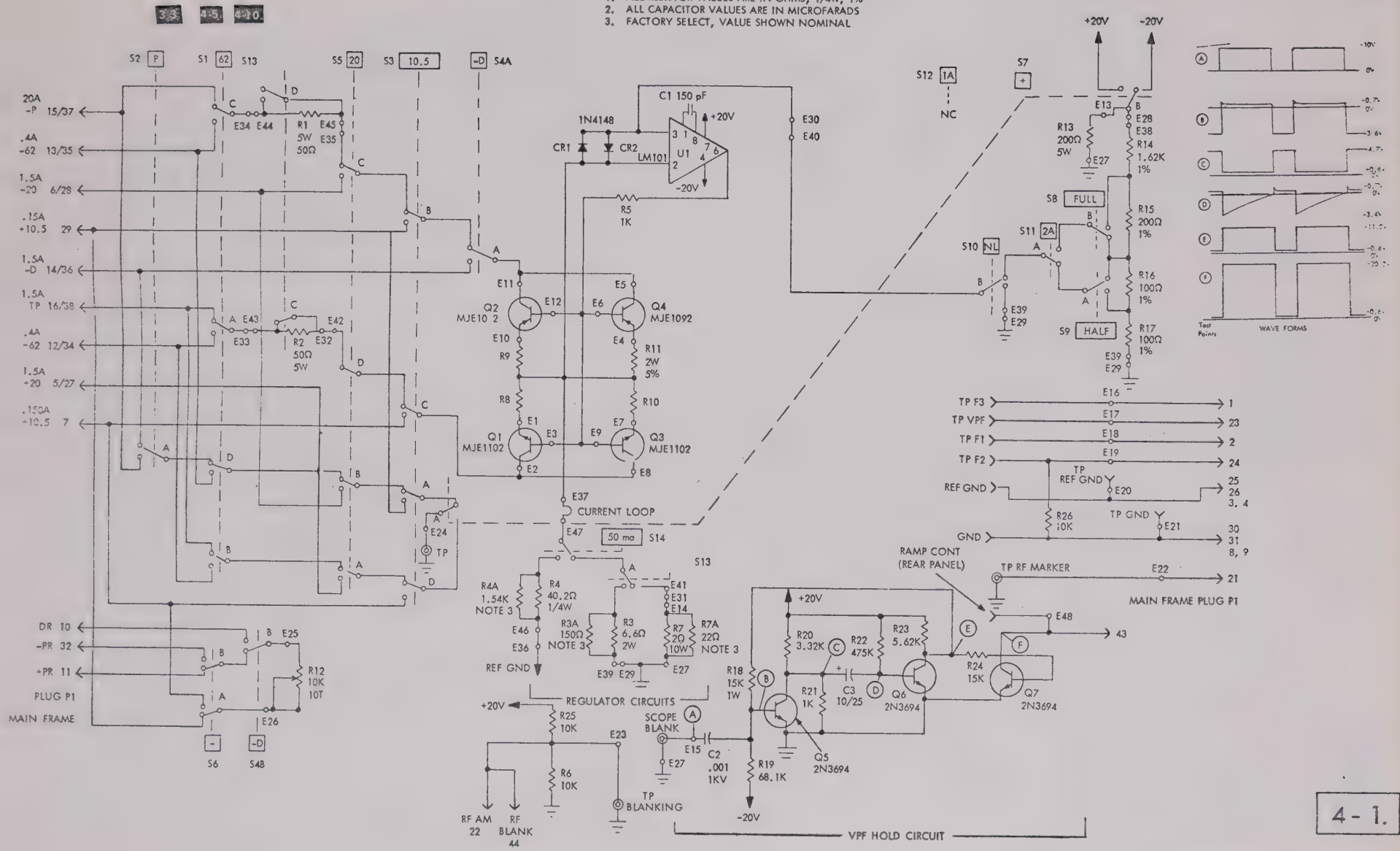
4-8. Note that faulty operation of a switch will obviously cause unexpected currents to flow or unexpected supplies to be loaded. Switching a load to or from a supply will cause a momentary change in voltage, hence monitoring supply voltage with an oscilloscope or a common d'Arsonville movement meter will show whether loads are being changed as switches are operated.

4-9. Accuracy of current regulation depends on values of resistors R3, R3A, R4, R4A, R7, R7A, R14, R15, R16 and R17. It also depends on +20V and -20V supply accuracy. If either voltage is not within ±1% of rating, repair the 6600(A) before continuing calibration of the voltage supplies under load. Since a 1% variation in the reference voltage (±20V) causes a 1% variation in the load current, less than 0.01% change should be caused in the voltage of any 6600(A) supply.

4-10. VPF HOLD CIRCUIT. Figure 4-1.

4-11. Tracing the signal from E15 at the input to Q5 through base and collector of Q5, base and collector of Q6 and base and collector of Q7 will show which stage fails to operate, if operation of the circuit is faulty. Use an oscilloscope to determine wave forms, which should be approximately as shown in Figure 4-1. If voltage at the collector of Q7 stays at ground, it can be because the 6600(A) does not supply current through pin 43 of the plug-in connector, or Q7 may be shorted. If Q7 is shorted the 6600(A) should not sweep at all.

NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 1%
2. ALL CAPACITOR VALUES ARE IN MICROFARADS
3. FACTORY SELECT, VALUE SHOWN NOMINAL



4 - 1.

Figure 4-1. Model 6602 Schematic Diagram

SECTION V
PARTS LIST

5-1. INTRODUCTION.

5-2. This parts list section includes all pertinent data necessary to locate, identify, and procure additional parts for the equipment. Parts are listed alphanumerically by reference symbol and include all replaceable electronic items. In some cases, values, ratings and manufacturer sources shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement of the part(s) removed from the equipment.

5-3. ORDERING INFORMATION.

5-4. The following instructions will aid in ordering parts from the parts list.

a. Address all inquiries or orders to:

CUSTOMER SERVICE
The Singer Company
3176 Porter Drive
Palo Alto, California 94304

b. Include the following information:

1) Model and Serial Number of instrument.
2) Singer Part Number.
3) Reference Symbol Number.
4) Description (as shown on Parts List).

5-5. HOW TO USE THE PARTS LIST.

5-6. Paragraphs 5-7 through 5-16 describe the use and meaning of the five columns included in the Parts List, Table 5-5. Table 5-1 lists the assemblies covered by the Parts List. Table 5-2 lists the manufacturer's code. Table 5-3 is a list of circuit reference symbols. Table 5-4 is a list of abbreviations used with this Parts List. Table 5-5 is a list of parts used in the Model 6602.

5-7 CIRCUIT REFERENCE.

5-8. The Circuit Reference Column contains an alphanumeric listing of parts as they appear on the equipment chassis, illustration, or schematic. The reference designation identifies the parts as to their component function in the instrument.

5-9 DESCRIPTION COLUMN.

5-10. The Description Column contains the identification of component parts, including all pertinent specifications. When the description column is used for a reference symbol for which no part exists, NOT ASSIGNED is placed in the column. In these instances, columns 3, 4, and 5 are left blank.

5-11 SINGER PART NUMBER COLUMN.

5-12. The Singer Part Number column contains the part number as designated by the Singer Company.

5-13 TRUE FSC NUMBER COLUMN.

5-14. The True FSC Number column references the manufacturer by an assigned code number, as listed in Federal Supply Code Handbook H4-2. For manufacturers not listed in the Handbook, a letter code will be assigned. Table 5-2 includes the manufacturer and his code designation.

5-15 TRUE MANUFACTURER'S PART NUMBER COLUMN.

5-16. The True Manufacturer's Part Number shown contains the part number as designated by the manufacturer of the part.

5-7 5-9 5-11 5-13 5-15 See Paragraphs Above

Model 6610ED Series

TABLE 5-5. REPLACEABLE PARTS MODEL 6610ED SERIES (CONTINUED)

CIRCUIT REFERENCE	DESCRIPTION	SINGER PART NO.	TRUE MFG. FSC NO.	TRUE MFG. PART NO.
A1	(Cont.)			
	RESISTORS			
R54	22.1 kΩ	59-22.1K	19701	MF5C-D-2212F
R55	10.0 kΩ	59-10.0K	19701	MF5C-D-1002F
R56	Factory Selected			
R57	4.02 kΩ	59-4.02K	19701	MF5C-D-4021F

TABLE 5-1. LIST OF ASSEMBLIES

NAME	SINGER PART NUMBER
Main Assembly	103-2201-001
Switch Assembly	103-2195-001

TABLE 5-2. FEDERAL SUPPLY CODE FOR MANUFACTURERS

FMC NUMBER	NAME AND ADDRESS OF VENDOR
03782	Singer Instrumentation; 3176 Porter Drive; Palo Alto, California 94304
04713	Motorola Semiconductor Products, Inc.; 5005 East McDowell Road; Phoenix, Arizona 85008
14655	Cornell-Dublier Electric Corp.; 50 Paris Street, Newark, New Jersey
18324	Signetics Corp.; 811 East Argues Ave; Sunnyvale, California 94086
19701	Electra Manufacturing Co; 800 North 21st; Independence, Kansas
71590	Centralab Division of Globe-Union Inc; 932 E. Keefe Ave.; Milwaukee, Wisconsin 53212
72982	Erie Technological Products Inc; 644 W. 12th Street; Erie, Pennsylvania 16512
73445	Amperex Electronic Co., Division of North American Phillips Co., Inc; Hicksville, New York
75042	IRC, Inc; 401 North Broad Street; Philadelphia, Pennsylvania 19108

TABLE 5-3. REFERENCE SYMBOLS

AT	Attenuator, Isolator	OI	Optical Isolator
C	Capacitor	P	Plug, Connector
CR	Diode	Q	Transistor
CD	Directional Coupler	R	Resistor
DS	Lamp	S	Switch
J	Jack, Connector	T	Transformer
K	Relay	U	Integrated Circuit
L	Inductor	Z	Miscellaneous Parts: Ferrite Beads (RF Choke)

TABLE 5-4. ABBREVIATIONS

AF	Audio Frequency, 30 Hz - 30 kHz	mV	Millivolts
Cer.	Ceramic	mW	Milliwatts
Comp.	Composition	No.	Number
Dep. Car.	Deposited Carbon	NPNT	N Pole N Throw (N=Digit)(S=Single)
DM	Dipped Mica	Oper. Ampl.	Operational Amplifier
Elec.	Electrolytic, Aluminum	P/O	Part of
EHF	Extremely High Frequency, 30 - 300 GHz	Pot.	Potentiometer
F	Frequency	pF	Picofarad
Fact. Sel.	Factory Selected	RF	Radio Frequency
Freq. Mul	Frequency Multiplier	Rect.	Rectifier
GMV	Guaranteed Minimum Value	SAF	Sub Audio Frequency, 0 - 30 Hz
GP	General Purpose	SHF	Super High Frequency, 3.0 - 30 GHz
HC	Hot Carrier (Diode)	Spec.	Special
HF	High Frequency, 3 - 30 MHz	Tant.	Tantalum, Electrolytic
IND-STD	Industry Standard	UHF	Ultra High Frequency, 300 - 3000 MHz (0.3 - 3.0 GHz)
k	Thousand	V	Volts
LED	Light Emitting Diode	Var.	Variable
LF	Low Frequency, 30 - 300 kHz	VHF	Very High Frequency, 30 - 300 MHz
m	0.001 (1/1000)	W	Watts
M	Million	WW	Wirewound
mA	Milliamperes	0 TC	Zero Temperature Coefficient
MF	Metal Film	%	± % if sign not shown
Med. Freq.	Medium Frequency, 300 - 3000 kHz	Ω	Ohms
Mfr.	Manufacturer	µF	Microfarads

TABLE 5-5. PARTS LIST

CIRCUIT REFERENCE	DESCRIPTION	SINGER PART NO.	TRUE MFG. FSC NO.	TRUE MFG. PART NO.
	MAIN ASSEMBLY	103-2201-001	03782	103-2201-001
	CAPACITORS			
C1	150 pF, ±10%, 1KV, fixed cer.	12-70	71590	DD-151
C2	.001 µF, ±10%, 1KV, fixed cer.	12-2	72982	851-X5R-102K
C3	10 µF, +75-10%, 25 V, fixed Elect.	150-5001-100ES	14655	NLW10-25
	DIODES			
CR1, CR2	G.P., 10 mA, 75 V	154-0013-001	IND-STD	1N4148
	TRANSISTORS			
Q1, Q3	NPN, 80 V, 70 W, B750 min.	81-295	04713	MJE1102
Q2, Q4	Darlington, PNP, 80 V, 70 W, B700	81-294	04713	MJE1092
Q5 thru Q7	NPN, 45 VC Max, 0.2 W, B100-400	556-146-677	IND-STD	2N3694
	RESISTORS			
	NOTE: Unless otherwise specified, all resistors are fixed 1/4 W, ±1% metal film.			
R5	1 KΩ	59-1.00K	19701	MF5C-D-1001F
R6	10 KΩ	59-10.0K	19701	MF5C-D-1002F
R7A	22 Ω, ±5%, 1 W, fixed Comp.	151-1004-220J	MILPN	RC32GF220J
R8 thru R11	.24 Ω, ±5%, 2 W, fixed WW	44-.24	75042	BWH 0.24 Ω ±5%
R18	15 KΩ	59-15.0K	19701	MF5C-D-1502F
R19	68.1 KΩ	59-68.1K	19701	MF5C-D-6812F
R20	3.32 KΩ	59-3.32K	19701	MF5C-D-3321F
R21	1 KΩ	59-1.00K	19701	MF5C-D-1001F
R22	475 KΩ	59-475K	19701	MF5C-D-4753F
R23	5.62 KΩ	59-5.62K	19701	MF5C-D-5621F
R24	15 KΩ	59-15.0K	19701	MF5C-D-1502F
R25, R26	10 KΩ	59-10.0K	19701	MF5C-D-1002F
	INTEGRATED CIRCUIT			
U1	Op. Amp.	84-1	18324	LM101A

TABLE 5-5. PARTS LIST (Continued)

CIRCUIT REFERENCE	DESCRIPTION	SINGER PART NO.	TRUE MFG. FSC NO.	TRUE MFG. PART NO.
	SWITCH ASSEMBLY	103-2195-001	03782	103-2195-001
	RESISTORS			
	NOTE: Unless otherwise specified, all resistors are fixed 1/4 W, ±1% metal film.			
R1, R2	50 Ω, ±5%, 5 W	61-25	44655	CAB-25-50Ω
R3	6.8 Ω, ±5%, 2 W , WW	151-2032-001	75042	BWH 6.8 Ω ±5%
R3A	150 Ω, ±5%, 1/2 W, Dep. Carb.	51-150	73445	E-009 AB/B
R4	40.2 Ω	59-40.2	19701	MF5C-D-40R2F
R4A	1.54 KΩ	59-1.54K	19701	MF5C-D-1541F
R14	1.62 KΩ	59-1.62K	19701	MF5C-D-1621F
R15	200 Ω	59-200	19701	MF5C-D-2000F
R16, R17	100 Ω	59-100	19701	MF5C-D-1000F

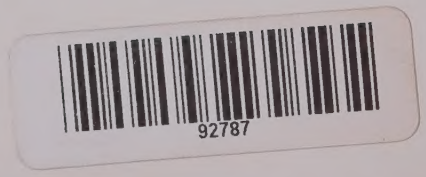
SHIPMENT DAMAGE CLAIM

The instrument should be tested as soon as it is received. If it fails to operate properly or is damaged in any way, a claim must be filed with the carrier. Have carrier agent inspect damage to instrument and packing crate and forward us a copy of his written report. You will then be advised of replacement or repair arrangements and disposition of the equipment. Please include model number, type number and serial number when referring to this instrument for any reason.

REPACKING FOR SHIPMENT

The instrument should be packed in the original carton. If unusable or not available, use a wooden box with approximately three inches of excelsior or other shock-absorbing material surrounding the instrument. If desired, packing services of a local transfer and storage company may be employed.

SINGER
INSTRUMENTATION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